Pacific Science (1982), vol. 36, no. 4


# Review of Hawaiian Pinnidae and Revalidation of *Pinna exquisita* Dall, Bartsch, and Rehder, 1938 (Bivalvia: Mytiloida)[1]

JOSEPH ROSEWATER[2]

ABSTRACT: Hawaiian Pinnidae consist of five species: *Pinna muricata* Linne, 1758, *P. bicolor* Gmelin, 1791, *Atrina vexillum* (Born, 1778), *Streptopinna saccata* (Linne, 1758), and the recently rediscovered *Pinna exquisita* Dall, Bartsch, and Rehder, 1938. Differentiating characters are discussed, and *P. exquisita* is redescribed.

MEMBERS OF THE BIVALVE FAMILY PINNIDAE normally live partially buried with the delicate posterior shell edge protruding above the substrate. They are extremely subject to breakage from storm waves and shifting sands, but they have considerable potential for repair of the shell through utilization of several unique structures that remove debris from the mantle cavity and reposition the mantle to form new shell. Repaired shells are seldom shaped like the original, however, resulting in great variation in form and sculpture. For this reason it is often difficult to identify a specimen without careful examination, and even then, considerable experience with specific variation may be required to recognize a species with any degree of confidence. A few attempts have been made in the literature to present an orderly classification of Pinnidae in different areas of the world (Turner and Rosewater 1958, Rosewater 1961). Recently dissatisfaction has been expressed with the state of knowledge regarding identities of Hawaiian Pinnidae (Burch 1980, Thorsson 1980). These criticisms are no doubt well taken, and it is my intent to attempt to clarify some of this confusion.

It is especially important when identifying pinnids to examine interior valve surfaces, for it is through study of the configuration of the nacreous layer that several generic and specific distinctions are made. If the interior nacreous area is divided by an anteroposteriorly directed sulcus into dorsal and ventral lobes, the specimen is a member of the genus *Pinna*. If there is only a dorsal nacreous lobe, it is a *Streptopinna*. If the nacreous area entirely occupies the anterior inner valve surface, it is an *Atrina* (Rosewater 1961: pl. 136).

In my monograph on Indo-Pacific Pinnidae (Rosewater 1961) I could identify only four species inhabiting Hawaiian waters: *Pinna muricata* Linne, 1758, *P. bicolor* Gmelin, 1791, *Atrina vexillum* (Born, 1778), and *Streptopinna saccata* (Linne, 1758). Since I believe there is only one Hawaiian species belonging to each of the latter two genera, examination of nacreous areas should confirm their identity. It is possible to identify with considerable certainty the specimen figured as *Streptopinna saccata* by Kay (1979: fig. 165*C*) without viewing the nacreous area because it is quite typical of that misshapen species. The specimen shown in her fig. 165*D* is more difficult to recognize, and it would be helpful to view the interior. It may also be *S. saccata*. Dall, Bartsch, and Rehder (1938) also reported one species each belonging to *Streptopinna* and *Atrina*, although they considered those species endemic to Hawaii. In my monograph on Indo-Pacific Pinnidae (Rosewater 1961) I considered *Streptopinna nuttalli* (Conrad, 1837) a synonym of *S. saccata*. *Atrina recta* Dall, Bartsch, and Rehder, 1938 was based on a number of immature and fragmented shells, although it is unquestionably an *Atrina*. Dall et al. described *Pinna oahua*, based on five reasonably mature fragments,

[1] Manuscript accepted 7 March 1982.

[2] National Museum of Natural History, Department of Invertebrate Zoology (Mollusks), Smithsonian Institution, Washington, D.C. 20560.

four of which closely resemble portions of young *Atrina vexillum* (the fifth fragment is the umbo of a *Lithophaga*). Since *A. vexillum* is the only recognizable Indo-Pacific *Atrina* as yet reported from Hawaii, I think it likely *Atrina recta* is also a synonym. There are a few records for *A. vexillum* in Hawaii indicating that its larvae may only occasionally reach the islands from the south and west (Rosewater 1961: 204).

Hawaiian members of the genus *Pinna* have proven difficult to identify in spite of attempts to classify them. Thorsson (1980) stated that described differences based on shape are useless in separating species, and I must agree that shape *is* most variable and apparently depends on habitat, nature of the substrate, current, presence or absence of protection from crushing, and so forth. The shell of the most common species, *Pinna muricata*, is extremely variable. It varies from broadly fan-shaped to narrowly wing-shaped. Color varies from unbanded light sand-tones, through banded with dark-brown, to overall darkly pigmented. Its narrow ribs may be sparsely spinose to smooth. One of the more characteristic features of *P. muricata* is that the shells tend to be rather inflated and rhomboidal in transverse section. Another distinctive characteristic is the overlapping of the posterior adductor muscle scar onto the ventral nacreous lobe (Rosewater 1961: pl. 141, fig. 2). This is most noticeable in older, thicker, or heavier individuals, and may be hard to detect in some specimens.

As is the case in *Atrina vexillum*, *Pinna bicolor* has been reported infrequently in Hawaii. It should be expected that if one finds a *Pinna*, it probably is *P. muricata*. Most Hawaiian *P. bicolor* I have seen are small, darkly pigmented, or with color rays; ribs are smooth and the shell is not very inflated. A few larger individuals have been collected recently (E. A. Kay, personal communication, 1981). The nacreous area configuration is somewhat variable, but generally it is as described in my monograph (Rosewater 1961: 195). The two lobes tend to be separated somewhat posteriorly, whereas in *P. muricata* they are closely approximated for most of their length (Rosewater 1961: 190). Dorsal nacreous lobes of both species are usually longer than ventral lobes. In *P. bicolor* the ventral lobe may have an oblique posterior margin and may be longer than the dorsal lobe when it reaches the ventral margin. In *P. muricata* the posterior border of the ventral lobe usually is rounded-truncate.

Dall, Bartsch, and Rehder (1938) recognized four species of *Pinna* in Hawaiian waters: *P. semicostata* Conrad, 1837, and three new species, *P. hawaiensis*, *P. exquisita*, and *P. oahua*. The latter I consider a synonym of *Atrina vexillum*, as noted above, and not a *Pinna*. The first two *P. semicostata* and *P. hawaiensis*, I consider synonyms of *P. muricata*. The remaining species, *Pinna exquisita*, was based on fragmented valves that I formerly considered to represent part of the variation of *P. muricata*. Recently I received, from dredgings of the National Marine Fisheries Service R/V *Townsend Cromwell*, several lots of a most distinctive *Pinna*, which when compared with the type lot of *P. exquisita* were found to exhibit the same unique features that prompted its description by Dall, Bartsch, and Rehder. A redescription of the species follows.

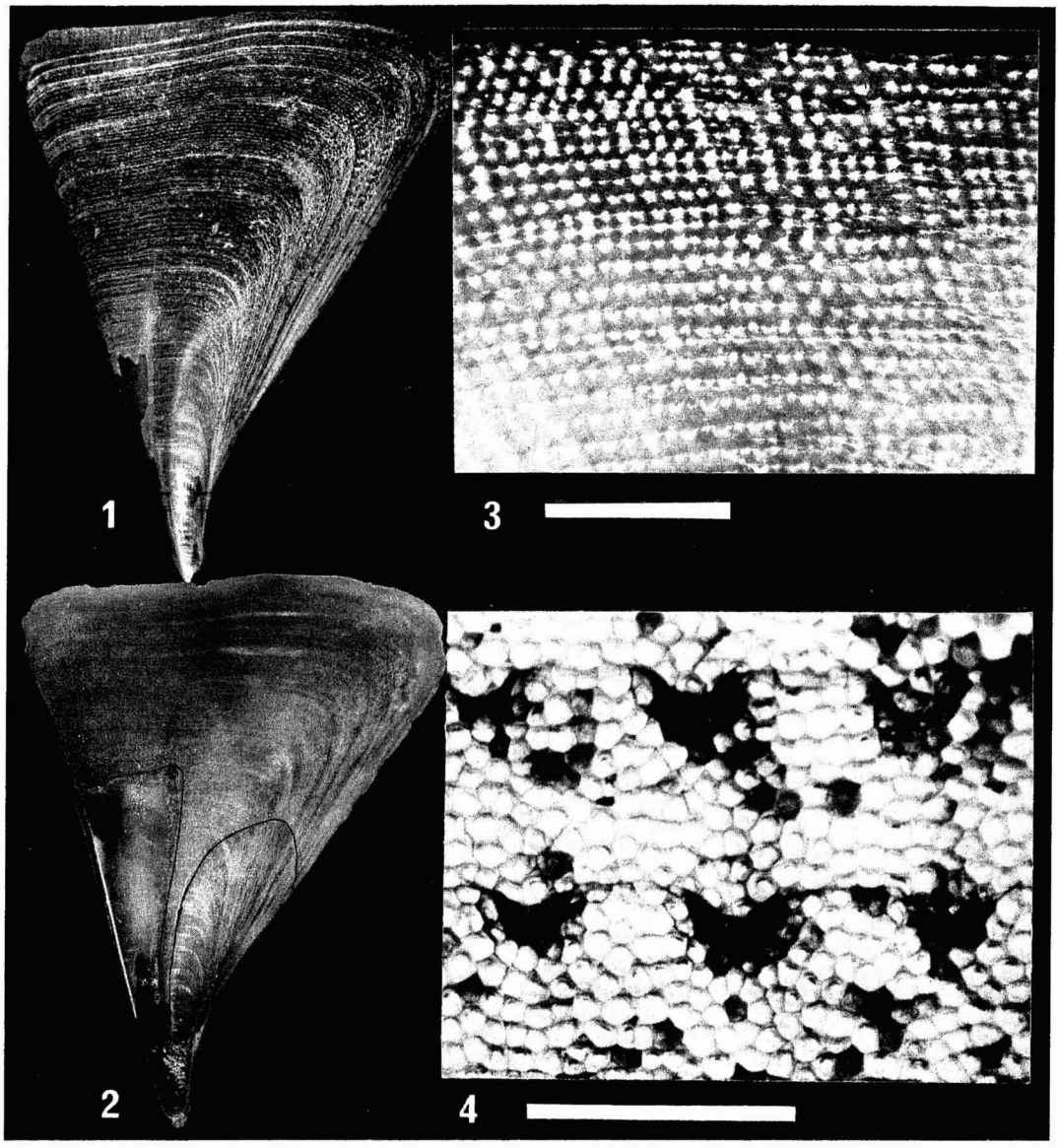
*Pinna exquisita* Dall, Bartsch, and Rehder, 1938

Figures 1–4, Table 1

1938 *Pinna exquisita* Dall, Bartsch, and Rehder, B. P. Bishop Museum Bull. 153: 75, pl. 17, figs. 1–2 (*Albatross* Sta.: 3965, near Laysan Island, Hawaii, in 147–116 fathoms on coral sand; Holotype USNM[3] 335610); 1961 Rosewater, Indo-Pacific Mollusca 1(4):190–191; 1979 Kay, Hawaiian Marine Shells: 515.

DESCRIPTION: Shell reaching 145 mm (nearly 5-3/4 in) in length; moderately to broadly fan-shaped, the posterior margin truncate, rounded, or lobate; moderately inflated, a 62 mm specimen is about 23 mm in breadth at the widest point (valves opposed); with a moderately weak longitudinal keel on the anterior half of the shell. Valves thin but strong and sculptured with low, very closely

[3] Specimen housed in National Museum of Natural History, formerly United States National Museum.




FIGURES 1 and 2. *Pinna exquisita* from NW of Maui, Hawaii, TC33-8. FIGURE 1. Exterior of left valve. FIGURE 2. Interior of right valve, nacreous lobes outlined; length 61 mm; USNM 818350.

FIGURE 3. *Pinna exquisita*, external view of shell enlarged to show overall fine spinosity; specimen from NW of Maui, TC33-9; white bar represents 5 mm; USNM 818351.

FIGURE 4. *Pinna exquisita* shell magnified and viewed with transmitted light to show large hexagonal crystals; black, semilunate structures are spines; white bar represents 1 mm; USNM 818351.

TABLE 1

MEASUREMENTS OF *Pinna exquisita* (mm)

| LENGTH | WIDTH | LENGTH DORSAL LOBE OF NACREOUS LAYER | LENGTH VENTRAL LOBE OF NACREOUS LAYER | L* DL/VL | LOCALITY |
|---|---|---|---|---|---|
| 61† | 46 | 41.4 | 36.0 | 1.2 | TC33-8§ |
| 66† | 50 | 44.8 | 34.7 | 1.3 | TC33-9 |
| 58† | 50 | 40.1 | 32.1 | 1.2 | TC33-9 |
| 145† | 100 | 78.3 | 57.9 | 1.4 | TC33-36 |
| 105† | 89 | 66.8 | 45.7 | 1.5 | TC33-36 |
| 129† | 99 | — | — | — | TC33-36 |
| 105† | 96 | 64.3 | 49.1 | 1.3 | TC33-38 |
| 117† | 98 | 64.7 | 48.5 | 1.3 | TC33-38 |
| 91† | 78 | 58.3 | 43.5 | 1.3 | TC33-38 |
| 63† | 60 | 39.2 | 29.6 | 1.3 | TC40-54 |
| 78‡ | 57 | 54.1 | 43.6 | 1.2 | TC40-54 |

*Ratio of length of dorsal lobe of nacreous layer to length of ventral lobe.
†Right valve.
‡Left valve.
§See R/V *Townsend Cromwell* stations under RECORDS.

spaced, almost microscopic radiating ribs. Shells translucent, from light tan to medium horn color, without noticeable color bands. Surface scabrous overall due to presence of closely spaced, short, erect spines on ribs, except where worn smooth. Radial sculpture consists of low, closely spaced, almost microscopic ribs on the broad posterior slope; new ribs become intercalated anteroposteriorly, and there are about 50 ribs near midlength and up to 100 near posterior margin in a 62 mm specimen; ribs on ventral slope become crowded and impossible to count. Ribs bear closely spaced, short, erect spines, which may be aligned longitudinally and transversely giving reticulated appearance that prompted name "*exquisita*." Concentric sculpture consists of lines of growth occasionally distorted by breakage and repair of valves. Posterior margin usually truncate. Dorsal margin nearly straight to concave. Ventral margin broadly concave. Interior of valves medium horn color, darker posteriorly, smooth, and lustrous. Nacreous layer hardly iridescent, instead with a silvery or whitish veil, occupying the anterior 1/2 to 2/3 of the interior of shell and divided along posterior 4/5 of its length by a moderately wide, longitudinal sulcus. Dorsal lobe of nacreous layer extending considerably farther posteriorly than ventral lobe. Dorsal lobe usually obliquely truncate posteriorly. Ventral lobe sloping rapidly and obliquely ventrally, increasingly widely separated from dorsal lobe, bluntly rounded posteriorly. Posterior adductor muscle scar subterminal on dorsal nacreous lobe, not extending onto ventral lobe or interlobe space. Primary hinge ligament thin, black, extending from anterior end of shell to posterior border of nacreous layer along dorsal margin. Secondary hinge ligament not colored, but evident in intact specimens whose dorsal borders are fused.

Embryonic valves not available for description.

Observations on anatomy of three animals from R/V *Townsend Cromwell* Cruise 33, station 38: preservation poor, anatomy grossly similar to species previously described (see Turner and Rosewater 1958, Rosewater 1961). Eyes of Will small, inconspicuous, flesh-colored, sparsely distributed posteriorly in middle mantle lobe. Intestine terminating at anus which projects freely above posterior surface of posterior adductor muscle. Pallial organ projecting from surface of rectal tissues dorsally; its tip, in flaccid state, is elongate-digitiform. Foot is small, elongate, with well-developed byssal groove; byssus well developed, its fibers fine, golden brown.

RECORDS (ARRANGED FROM WEST TO EAST IN HAWAIIAN CHAIN): near Laysan Island, U.S. Bureau of Fisheries Vessel *Albatross* station 3965: [approximately 25°50′ N; 171°50′ W], 194–269M, 23 May 1902 (type locality, USNM 335610).

W of Molokai, NMFS R/V *Townsend Cromwell* station TC40-25:* 21°10′ N; 157°30′ W, 181M, 10 November 1968, —fragments; TC40-20:* 21°9.8′ N; 157°29.9′ W, 183M, 9 November 1968, —1 juvenile.

S of Molokai, TC35-38:* 21°2.1′ N; 157°3′ W, 274M, 8 April 1968, —2 juveniles, —3 adults.

S of Lanai, TC33-42:* 20°43.7′ N; 156°50.6′ W, 214–221M, 11 November 1967, —1 juvenile.

NW of Maui, TC33-11:* 21°1.9′ N; 156°47.7′ W, 227–230M, 31 October 1967, —fragments; TC33-9: 21°0.1′ N; 156°45.7′ W, 227–234M, 30 October 1967, —3 specimens and fragments, USNM 818351; TC33-8: 21°0.3′ N; 156°45.4′ W, 223–238M, 30 October 1967, —1 specimen, USNM 818350; TC40-54: 21°01.6′ N; 156°43′ W, 223M, 18 November 1968, —2 specimens, USNM 818353.

W of Maui, TC33-36: 20°41.1′ N; 156°41.2′ W, 292–296M, 9 November 1967, —3 specimens, USNM 818352; TC33-38: 20°41.3′ N; 156°41′ W, 289–296M, 9 November 1967, —3 specimens, USNM 804476.

Off Waikiki, Hawaii, 347M, —1 valve and fragment, Bernice P. Bishop Museum (BPBM).

RANGE: Known from the type locality near Laysan Island and from collections of NMFS R/V *Townsend Cromwell* NW and W of Maui, W and S of Molokai, and S of Lanai, Hawaii (see RECORDS). Found in depths of from 181–296M (a single valve and fragment from off Waikiki in 347M).

REMARKS: Knowledge of the Exquisite *Pinna* is based on the holotype dredged in 1902 and several additional valves that were dredged in 1967–1968 (see RECORDS). These specimens are surprisingly alike, for *Pinna*, in details of shape, sculpture, pattern of the nacreous area lobes, and prominence of prismatic structure (Figures 1–4). When additional specimens become available it would not be surprising to find that some of these characters vary.

*Pinna exquisita* is broadly fan-shaped-lobate to squarely truncate posteriorly. *Pinna muricata* is usually narrower, although frequently squarely truncate posteriorly; *P. bicolor* is rounded or has an oblique posterior margin. In its exterior appearance the most striking feature in *P. exquisita* is the large number of closely spaced radiating ribs on the posterior slope, up to 100, compared with up to 26 in *P. muricata* and only 17 in *P. bicolor*. The short, closely spaced spines are another differentiating character. In *P. exquisita* they may form an overall rough surface, although occasionally worn smooth; in *P. muricata* spines occasionally may be numerous but do not entirely cover valve surfaces. They also are longer and more erect. Spines in *P. bicolor* usually are nearly obsolete. On interior surfaces of *P. exquisita* valves there is wide separation between dorsal and ventral lobes of the nacreous layer. The dorsal lobe has a straight ventral edge that follows the line of the longitudinal sulcus. The ventral lobe separates after about 1/5 its length and thereafter diverges increasingly. In both *P. muricata* and *P. bicolor* the two lobes are much closer together, hardly diverging from the sulcus for most of their lengths.

SUMMARY

Hawaiian Pinnidae consist of the following species with indicated frequencies of occurrence.

*Pinna muricata* Linne, 1758—common

*Pinna bicolor* Gmelin, 1791—moderately rare

*Pinna exquisita* Dall, Bartsch, and Rehder, 1938—rare

*Atrina* (*Atrina*) *vexillum* (Born, 1778)—rare

*Streptopinna saccata* (Linne, 1758)—common

* Fide B. Burch (not seen).

ACKNOWLEDGMENTS

The following persons supplied specimens and station data: B. Burch and D. Devaney (BPBM) and R. S. Shomura (NOAA). Y. Kondo and C. Christensen permitted me to examine specimens in the B. P. Bishop Museum collection of mollusks. E. A. Kay and W. Thorsson supplied information on Hawaiian Pinnidae. T. A. Burch and H. A. Rehder provided helpful criticism of the manuscript.

## LITERATURE CITED

BURCH, B. L. 1980. Action in the pen-shell beds. Haw. Shell News 28(7):1, 14.

DALL, W. H., P. BARTSCH, and H. A. REHDER. 1938. A manual of the recent and fossil marine pelecypod mollusks of the Hawaiian Islands. Bernice P. Bishop Museum Bulletin 153:1–233, 58 plates.

KAY, E. A. 1979. Hawaiian marine shells. *In* Reef and shore fauna of Hawaii. Sec. 4: Mollusca. B. P. Bishop Mus. Spec. Pub. 64(4):xviii + 653 pp.

ROSEWATER, J. 1961. The family Pinnidae in the Indo-Pacific. Indo-Pacific Mollusca 1(4):175–226.

THORSSON, W. 1980. Observations on Hawaii's *Pinna* population. Haw. Shell News 28(7):1, 15.

TURNER, R. D., and J. ROSEWATER. 1958. The family Pinnidae in the western Atlantic. Johnsonia 3(38):285–326.